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### Photo-/Electro-chemical CO<sub>2</sub>-recycling: from disposal to resource

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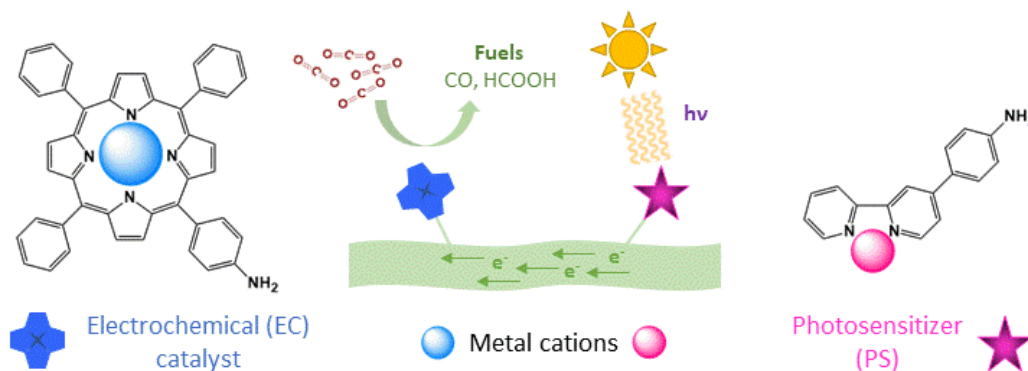
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The most distressing task of Anthropocene is to find an effective process to convert renewable feedstocks of otherwise disposable materials into exploitable, cheap fuels and chemicals via sunlight-driven processes. This project targets the production of small, transportable molecules with high energy content, starting from CO<sub>2</sub> as raw material. The overarching goal is to simultaneously target the mitigation of climate change and the principles of circular economy.

The strategy is based on the synergistic action of orthogonal photo- and electro-catalysts able to drive the photoelectrochemical (PEC) conversion of CO<sub>2</sub>. In particular, an array of metal-coordinating porphyrin-derivatives with appended amine groups has been synthesized and tested in homogeneous phase as plausible electrochemical (EC) catalyst,<sup>1</sup> whereas organometallic Mo-/Mn-based complexes bearing terminal amino moieties have been tested as photosensitizers (PS).<sup>2</sup>

A screening of the selected porphyrins showed a promising EC behaviour. Cyclic voltammetry data exhibit values of standard reduction potential ( $E^\circ$ ) for these molecules between -1.155 and -0.097 eV, i.e., compatible with CO<sub>2</sub> reduction. Further, the photochemical and photophysical characterization of the substrates suggests the possibility to exploit both catalysts simultaneously without facing electron transfer (ET) processes.

These preliminary results suggest the possibility to covalently link the tested molecules on an inert matrix in order to perform heterogeneous catalysis in view of a further optimization and scalability of the system.



**Figure 1:** schematic representation of the selected molecules envisaged for targeting CO<sub>2</sub> reduction.

#### References:

[1] Z. Liang, H. Wang, H. Zheng, W. Zhang and R. Cao, *Chem. Soc. Rev.*, **2021**,50, 2540-2581

[2] J. Bonin, A. Maurin and M. Robert, *Coord. Chem. Rev.*, **2017**, 334, 184-198